Spot-4 (Take 5) workshop
November 18th & 19th 2014, Toulouse

Phenological monitoring of tropical forest ecosystems (North of Congo)

Bolot, J.-F., Gond, V., Gourlet-Fleury, S., Cornu, G.

CIRAD
Forest ecosystems goods and services
Montpellier

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CONTEXT

- Central African forests cover 1,6 Mkm² and are of prime importance at the atmosphere/biosphere interface

- At this time we have a poor knowledge of these forest ecosystems

- These ecosystems are complex with spatial (forest types) and temporal (phenology) heterogeneities

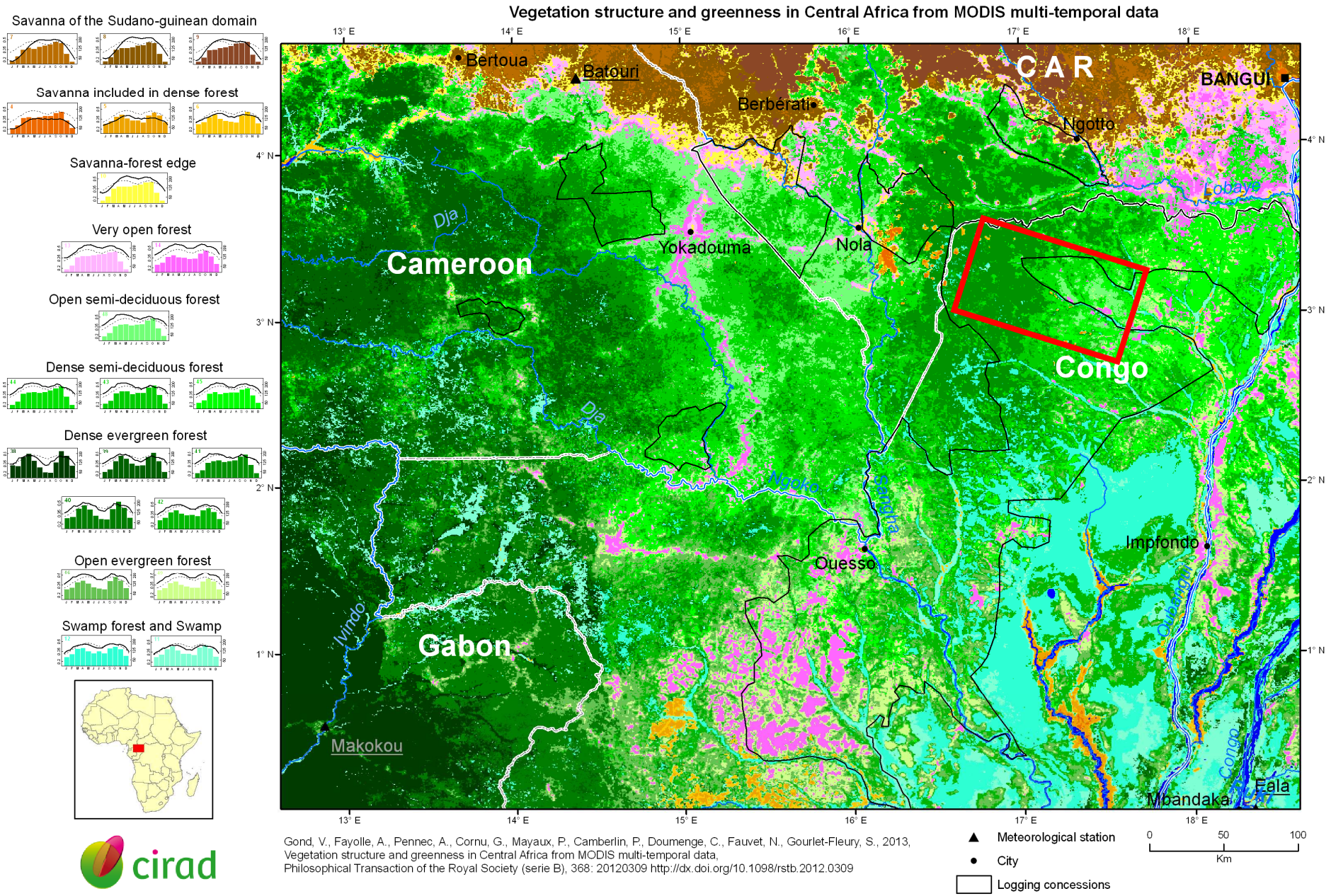
HYPOTHESIS

- Without accurate characterization of these ecosystems we will be poorly prepared to adopt sustainable management to face global changes (social changes and climate changes)

OBJECTIVE

- Improve Central African forests knowledge by mapping spatial patterns of structure and greenness using satellite images

Central African forests characterization



Gond, V., Fayolle, A., Pennec, A., Cornu, G., Mayaux, P., Camberlin, P., Doumenge, C., Fauvet, N., Gourlet-Fleury, S., 2013, Vegetation structure and greenness in Central Africa from MODIS multi-temporal data, Philosophical Transaction of the Royal Society (serie B), 368: 20120309 http://dx.doi.org/10.1098/rstb.2012.0309

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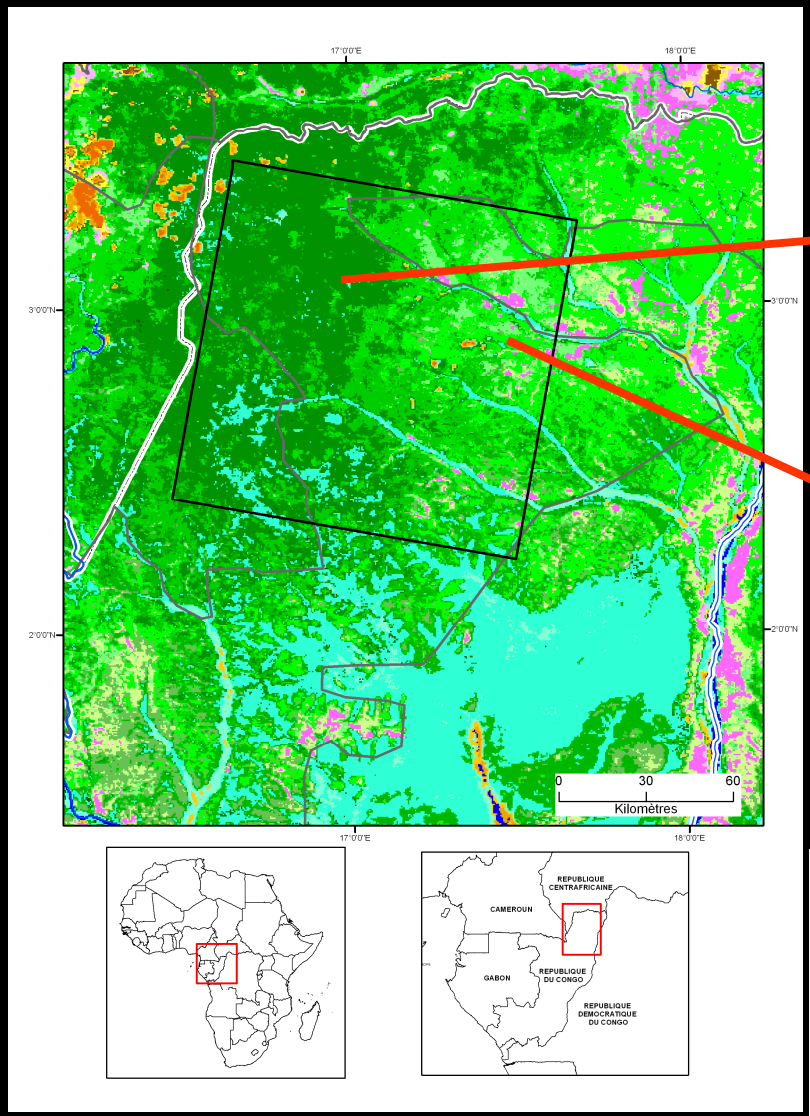
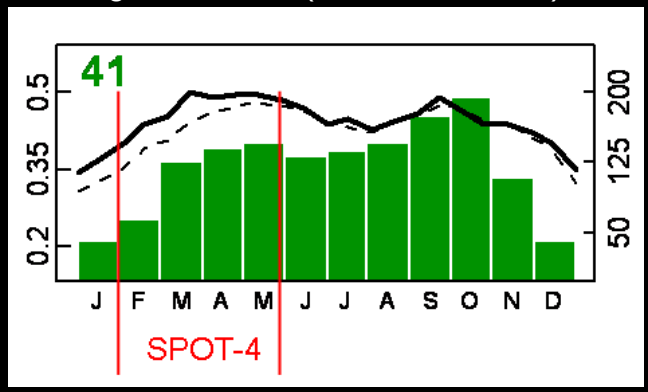
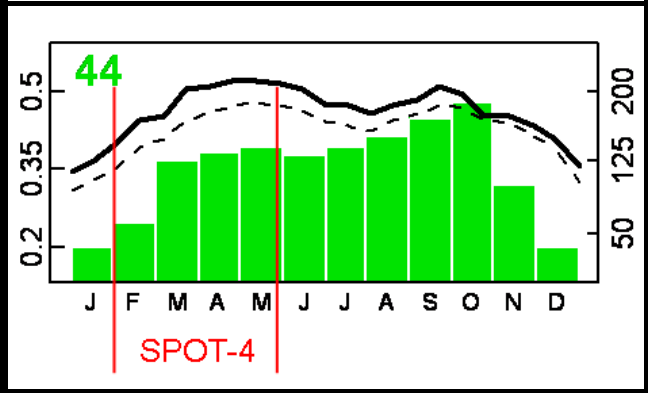
Different phenologies for different forest types

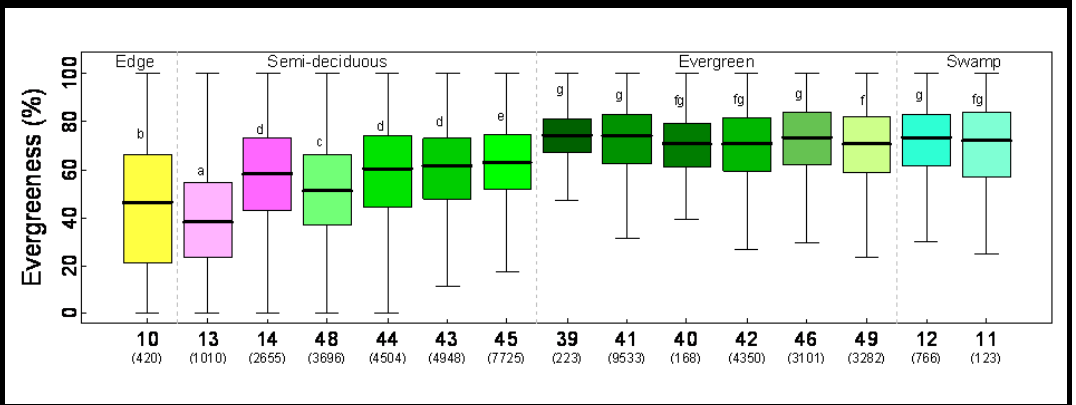


Evergreen forests (<30% deciduous)



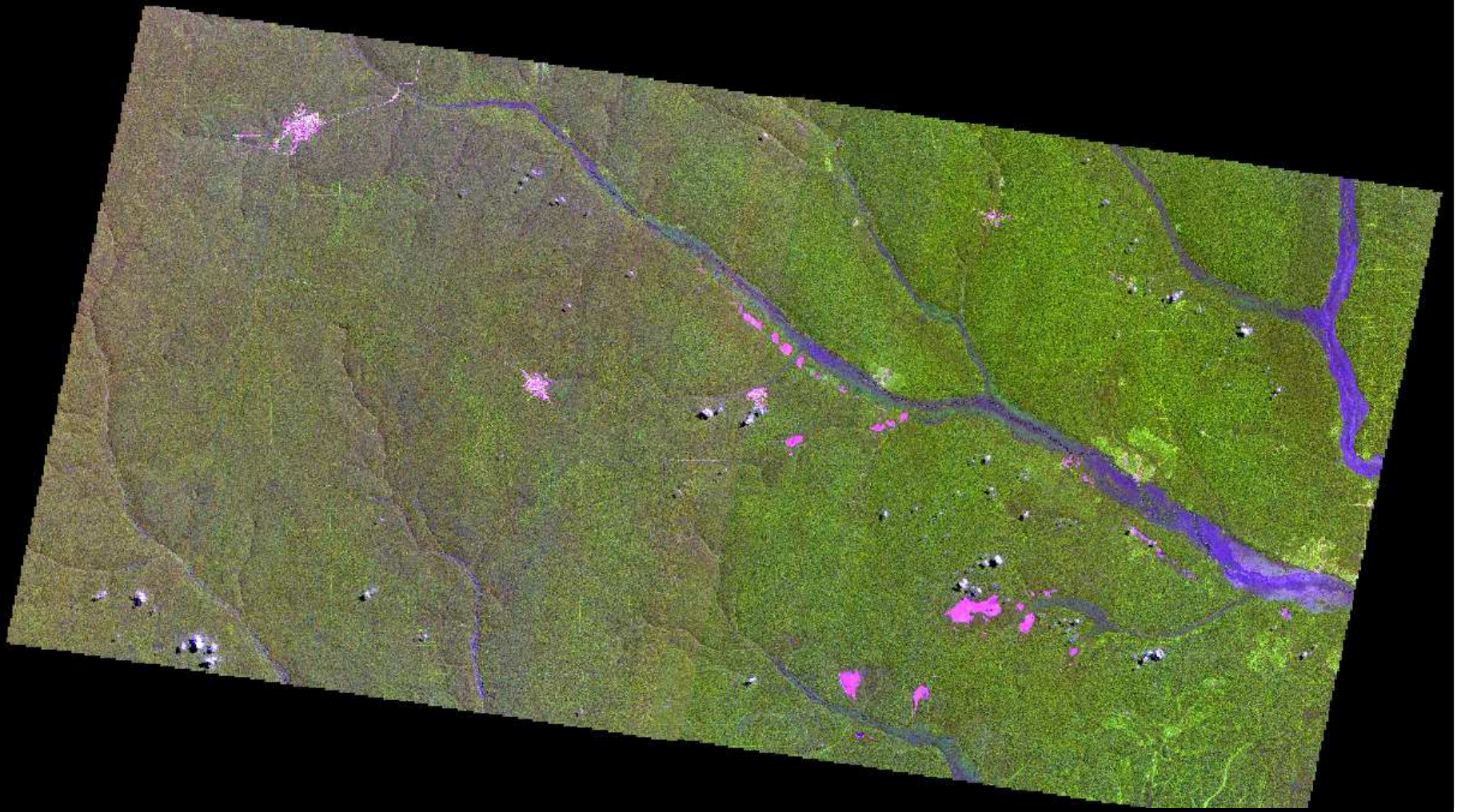


Semi-deciduous forests (>40% deciduous)



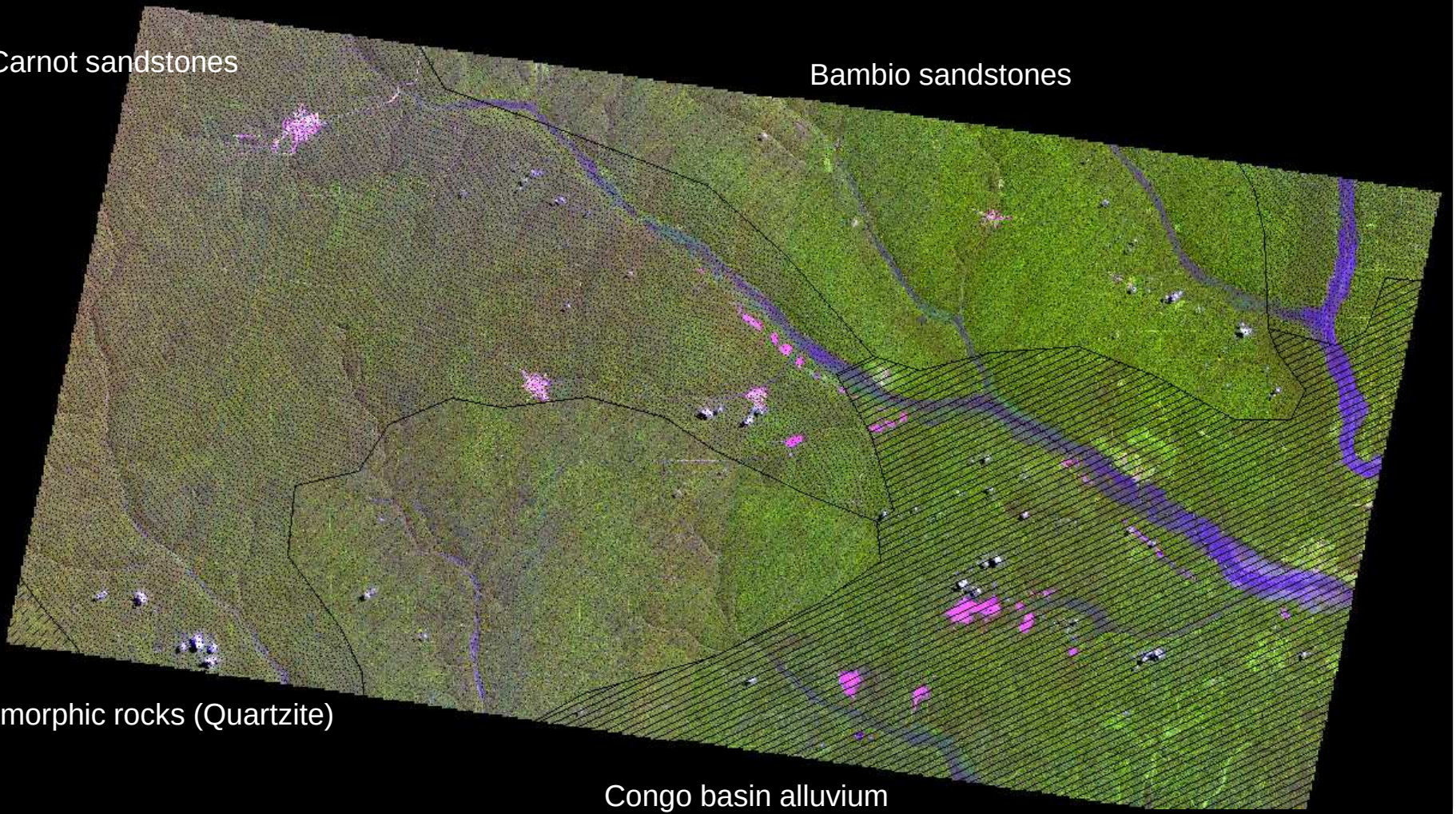
Structure and functioning
of forest types are identified with
37.898 inventory plots (1/2 ha)

Spot-4 (Take-5) data, Congo-1



Spot-4 (Take 5)
Congo 1

Geology, Congo-1



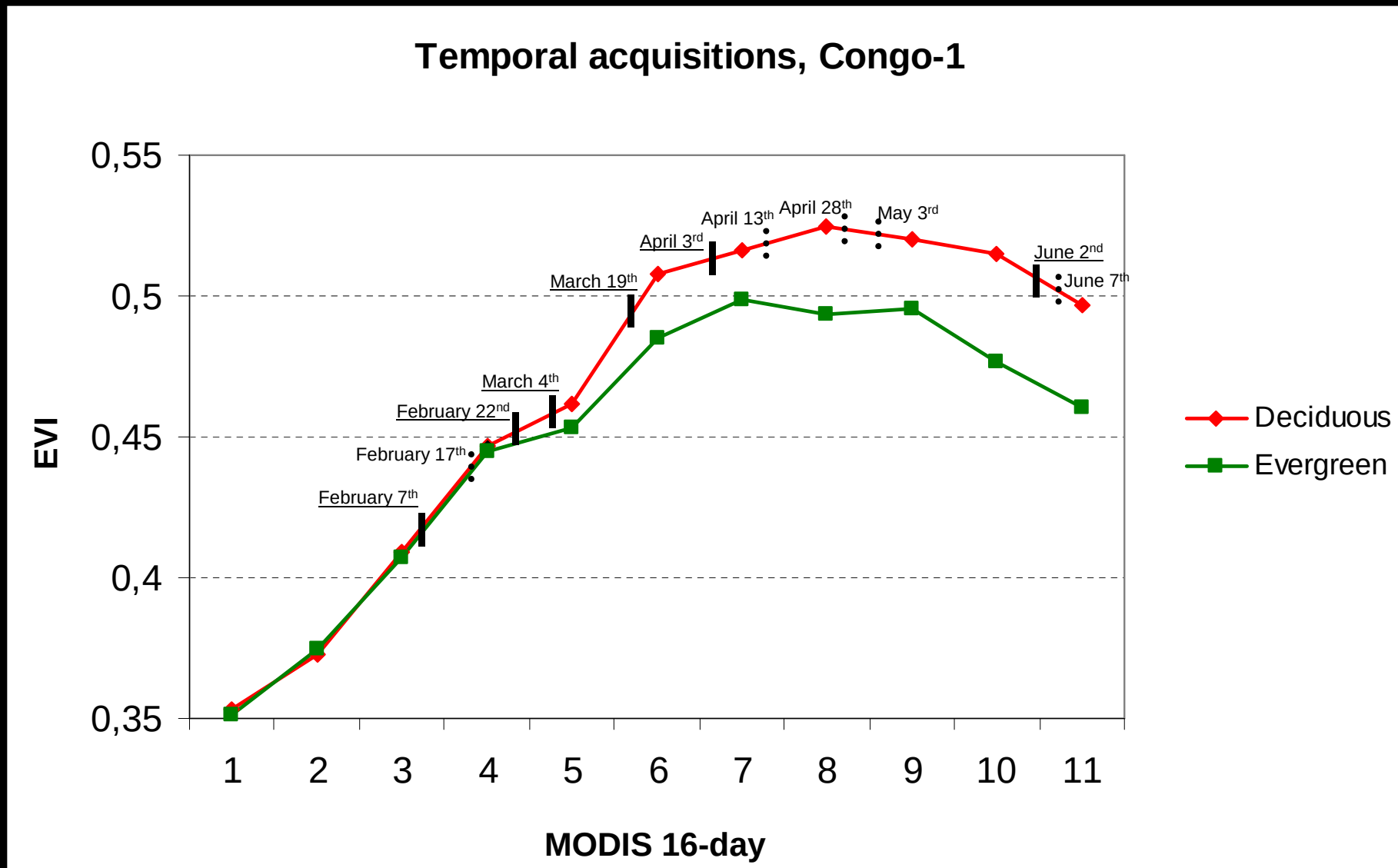
Spot-4 (Take 5)
Congo 1

Forest types (from MODIS), Congo-1

Evergreen forests (<30% deciduous)

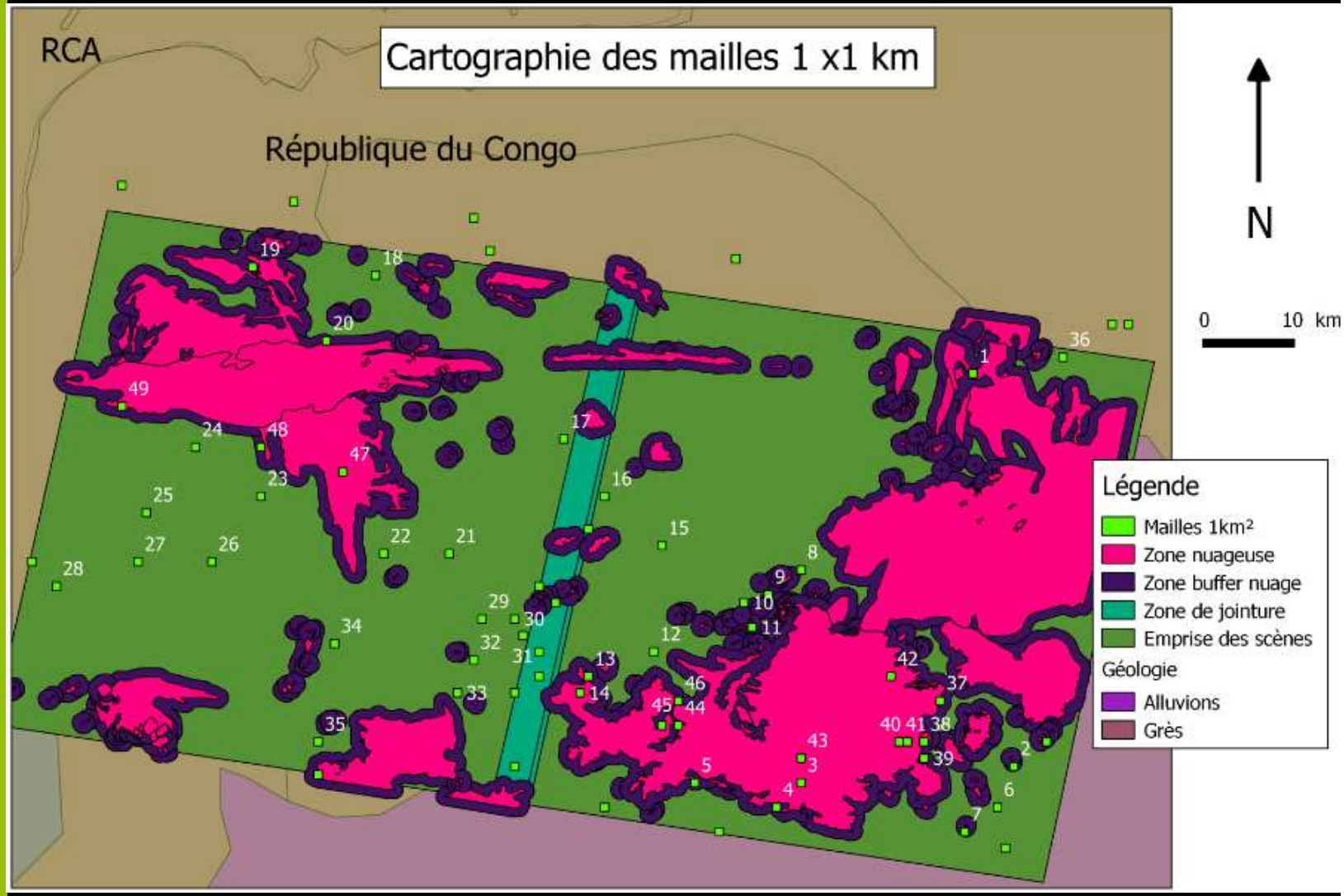
Semi-deciduous forests (>40% deciduous)

MODIS and Spot-4 temporal acquisitions (Take-5), Congo-1

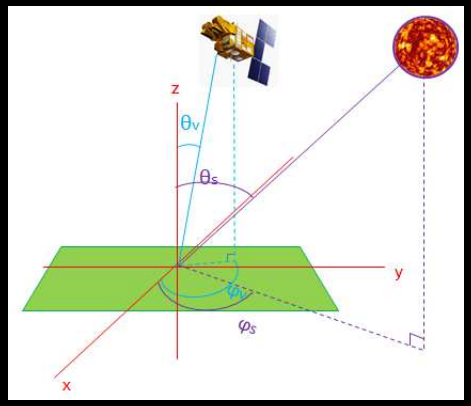


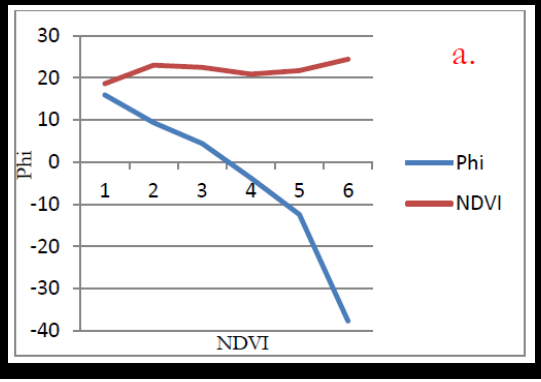
Spot-4 (Take 5)
Congo 1

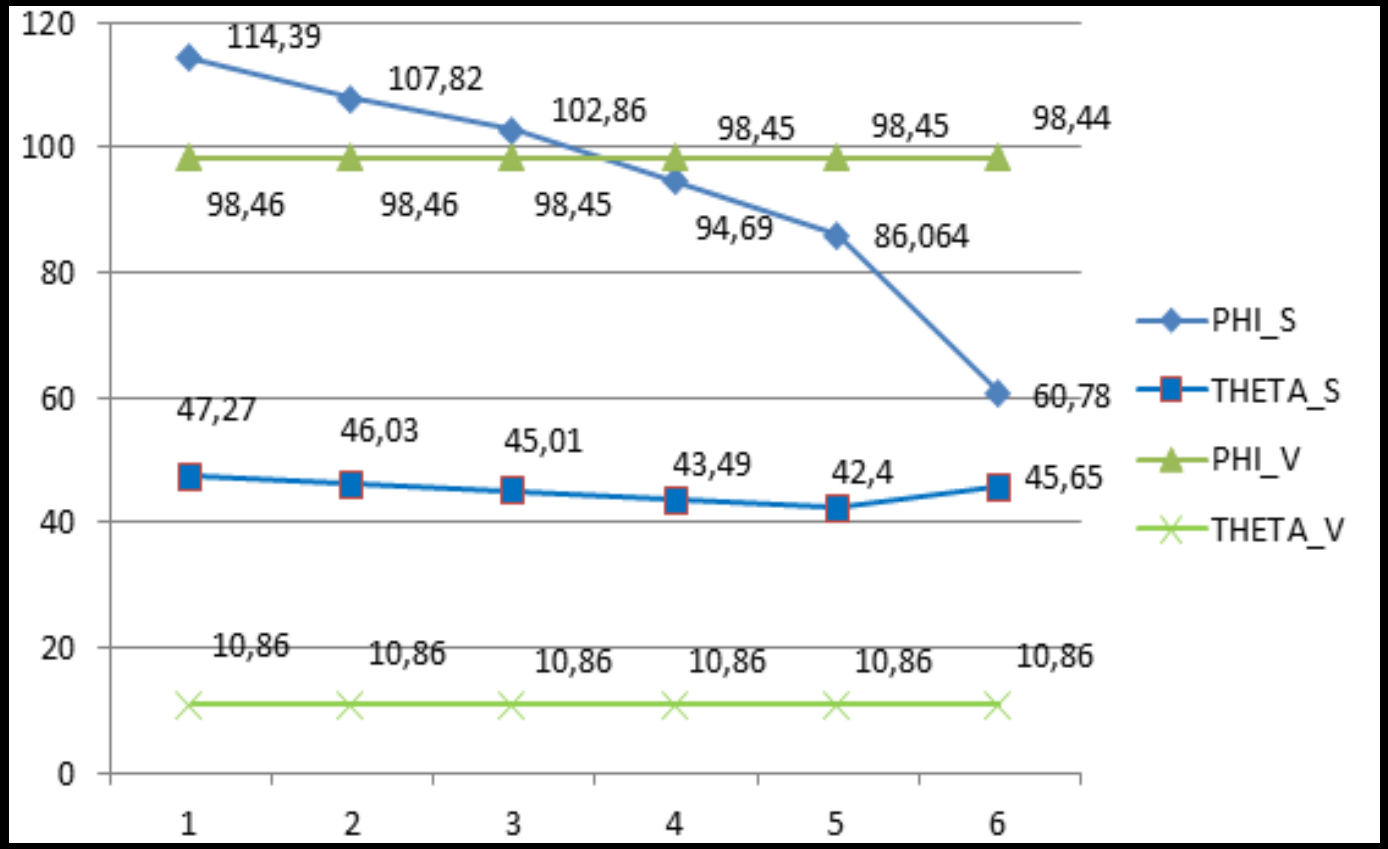
Available inventory plots and cloud contamination



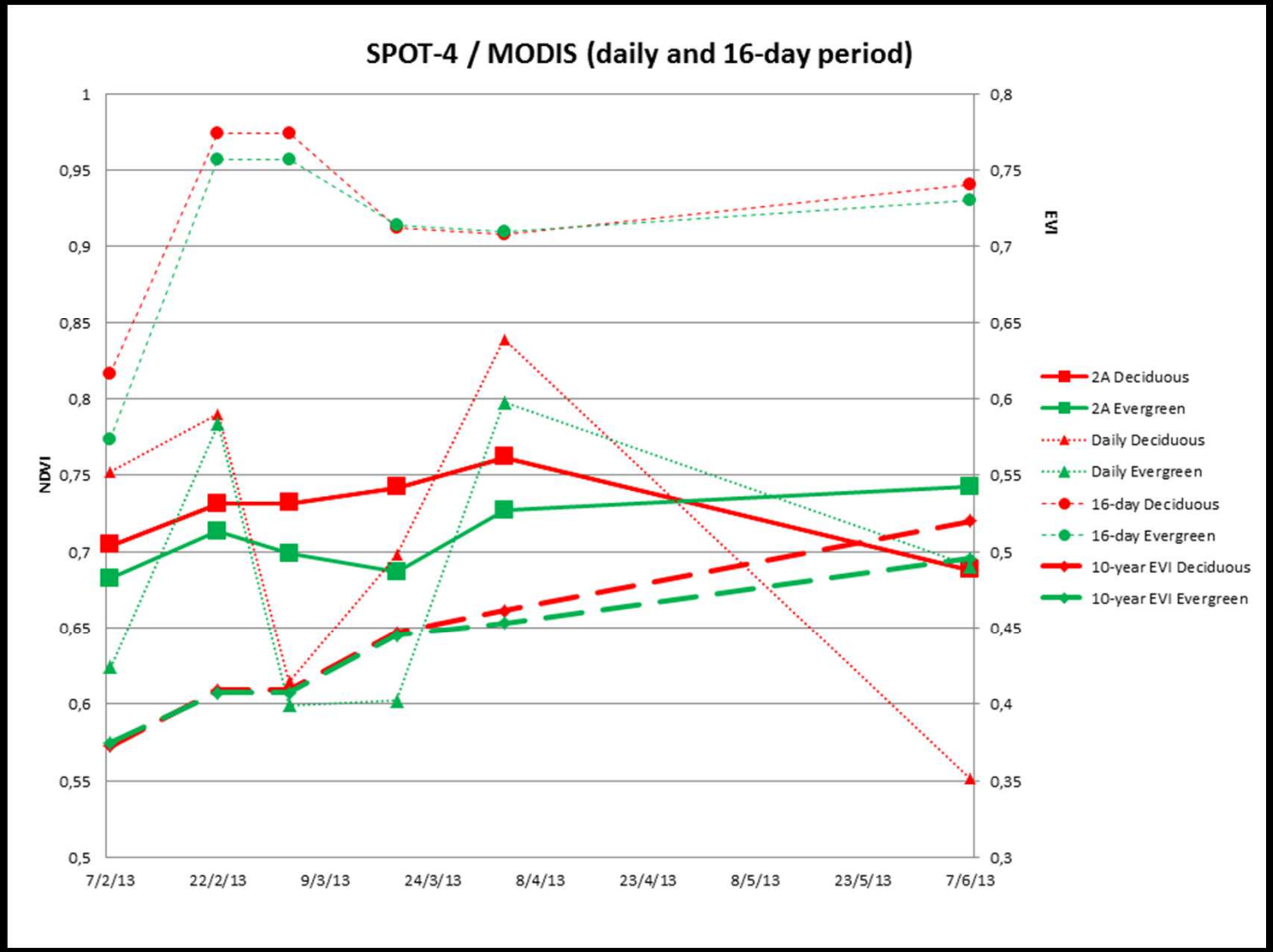
Conditions of measurements





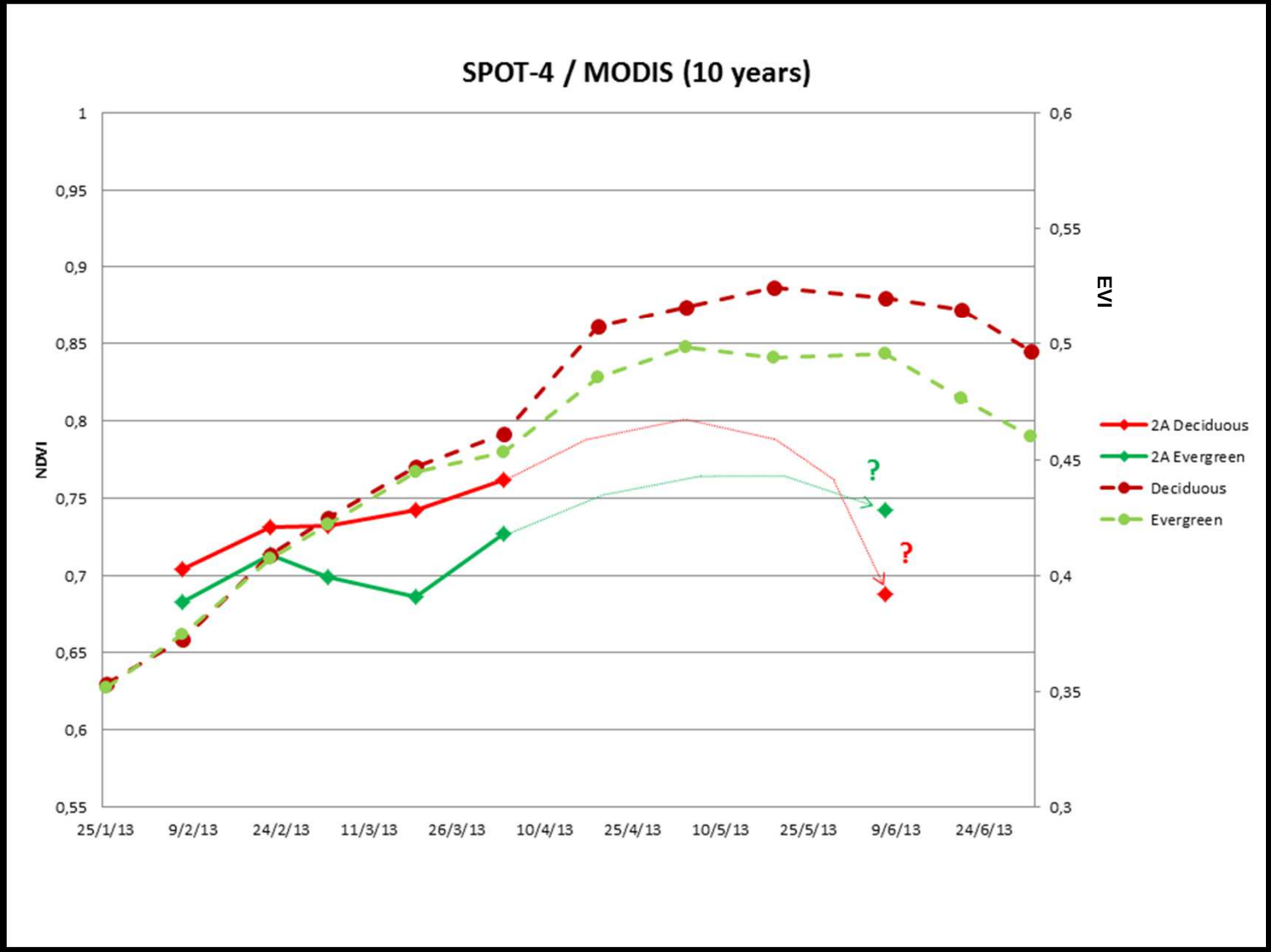


Comparison with MODIS measurements



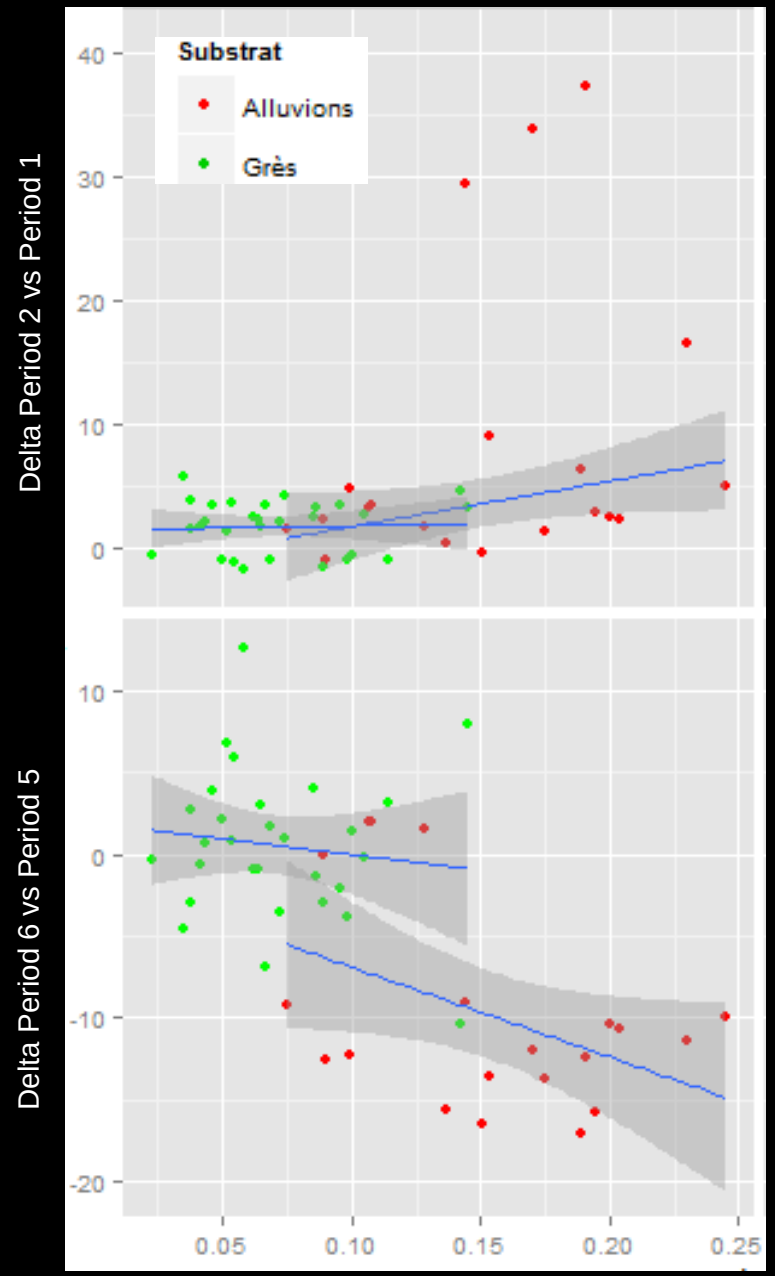
Stable daily measurements

Comparison with 10-years MODIS data



Questionable year to year dynamic

Detection of start and end of vegetation cycles



Faster starting period for deciduous forest on alluvions

Deeper decrease period for deciduous forest on alluvions

Regular dynamic for evergreen forest on sandstones

Specific conclusions with Spot-4 (Take-5) data, Congo-1

Very satisfactory Spot-4 (Take-5) data set acquisition

- Photosynthetic activity measurements are effectively a biologic signal (Morton et al., 2013). Significance de-correlation with R^2 from 0,2 to 0,4.

- More accurate monitoring compared to MODIS of phenological signal and good differentiation of evergreen and semi deciduous stands.

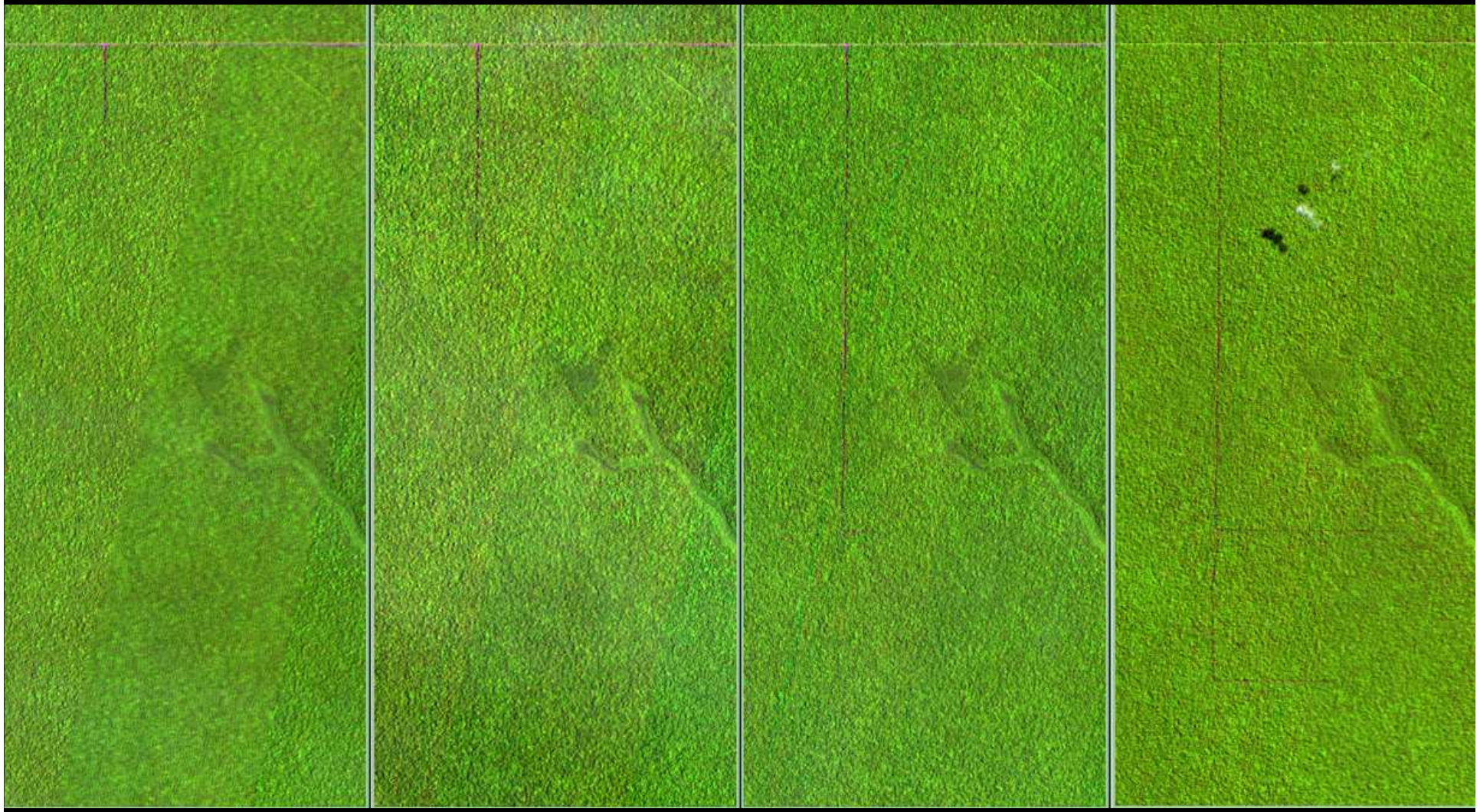
- Good identification of the start and the end of the vegetative activity for both stands.

Next questions are:

- Is it possible to monitor human activities?

- A focus on degraded forest characterization has to be done

Monitoring logging activities : forest tracks



March 4th — April 3rd — April 13th — June 2nd

30 days — 10 days — 50 days

Opening — Logging

Spot-4 (Take 5)
Congo 1

Next steps

Involve in SPOT-5 (take-5) in 2015:

- Focus on a temperate mountainous forest in north-Iran

- Be aware about the relief and slope influences on measurements

- Keep going on phenology monitoring

- Analyzing for each forest types phenological phases and determining the ecological process

- Developing forest management recommendations at timber plot scale within the continuous acquisition data program at high temporal and spatial resolution (Sentinel-2)

Thank you for your attention